The subseasonal-to-seasonal variability of Northern Hemisphere midlatitudes and its influence on forecasts for weeks 3-4

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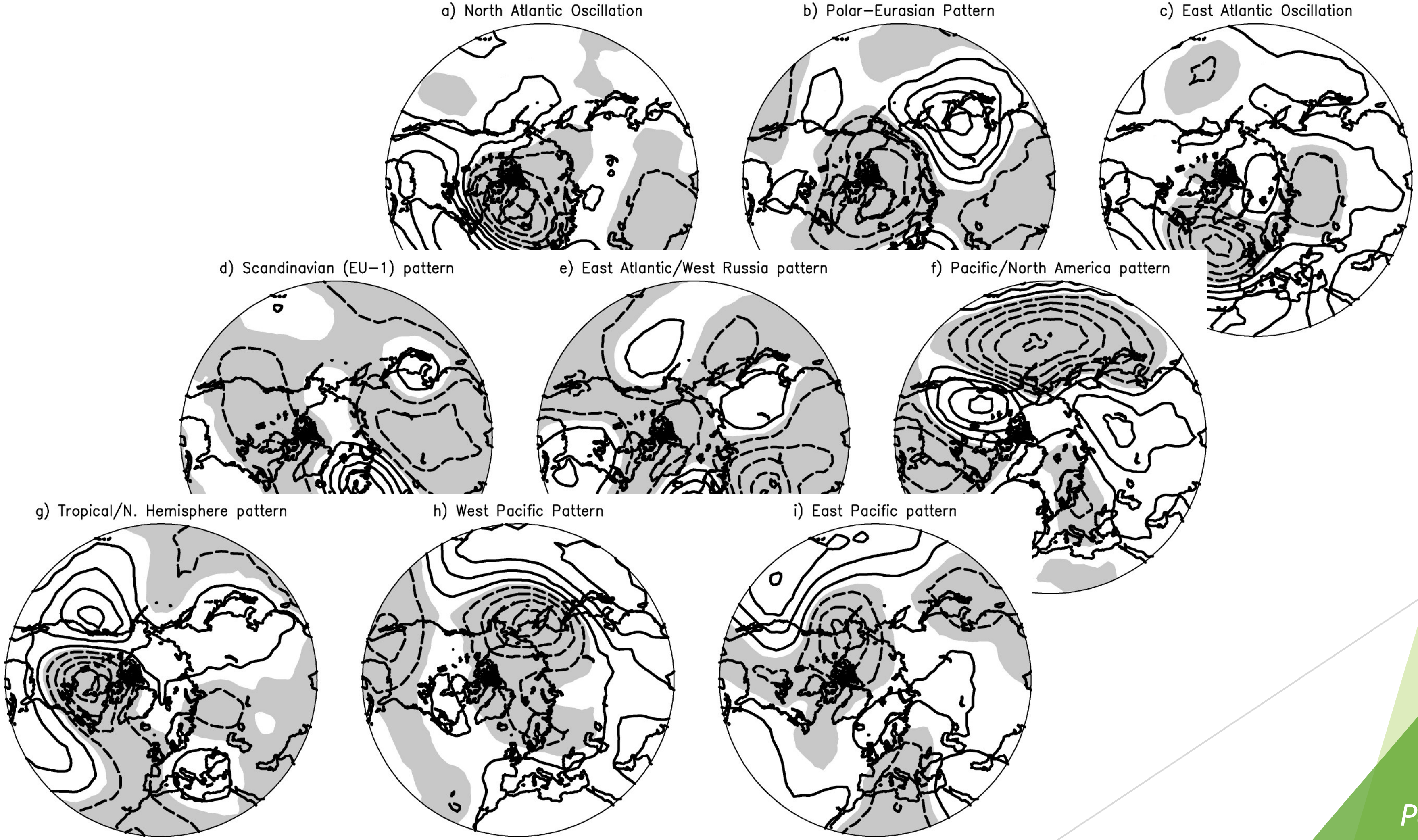
Sources of predictability for Weeks 3-4

- Observations:
  - Surface air temperature over North America in winter tends to be anomalously warm 10-20 days following the MJO phase 3 (Lin and Brunet, 2009)
- Statistical models:
  - The forecast range of North America temperature anomalies can be extended beyond 10-20 days especially for strong MJO cases (Yao et al., 2011; Rodney et al., 2013; Johnson et al., 2014)
- DelSole et al., 2017:
  - The most predictable components of winter precipitation of temperature over the CONUS are related to ENSO
  - Other predictable components are related to the MJO

Teleconnections

Mid-latitude Teleconnection Patterns

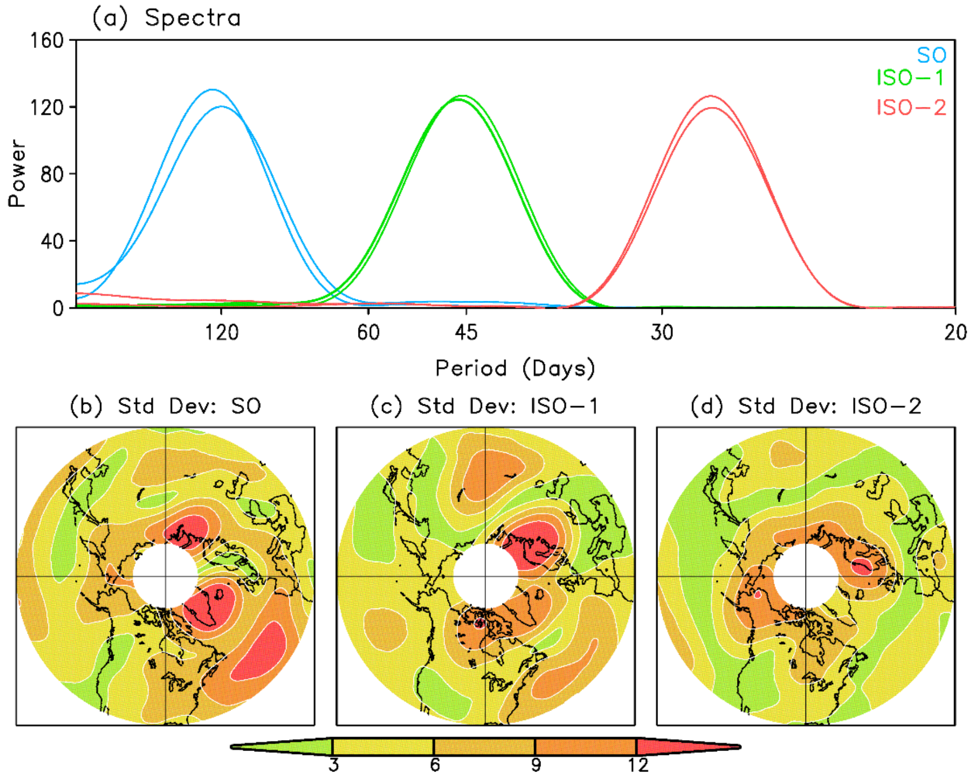
- Do teleconnection patterns of mid-latitude offer any sources of predictability?



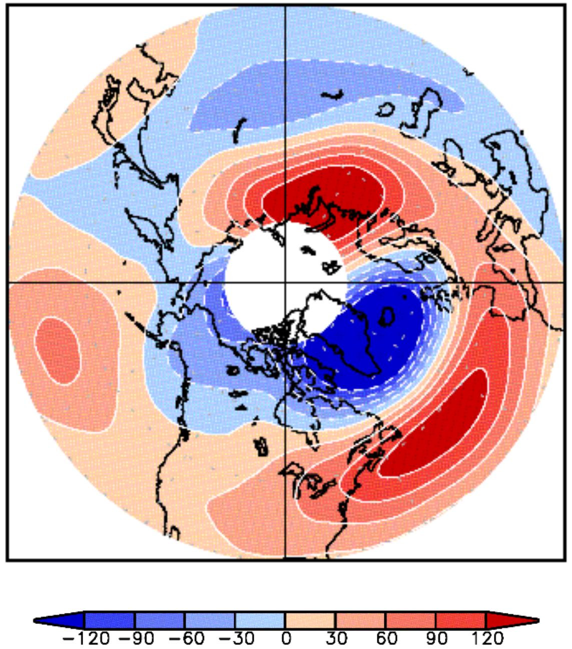
Panagiotopoulos, F. et al., 2002

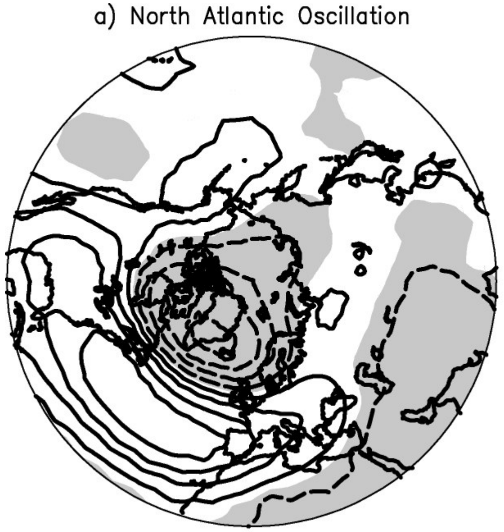
Mid-latitude Variability

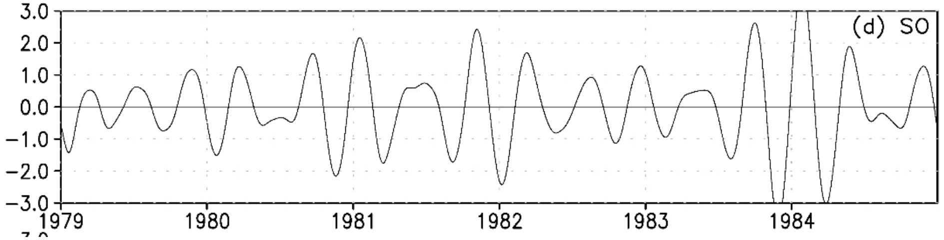
Data adaptive method (MSSA) applied to 500-hPa geopotential height daily anomalies between 1979-2012:



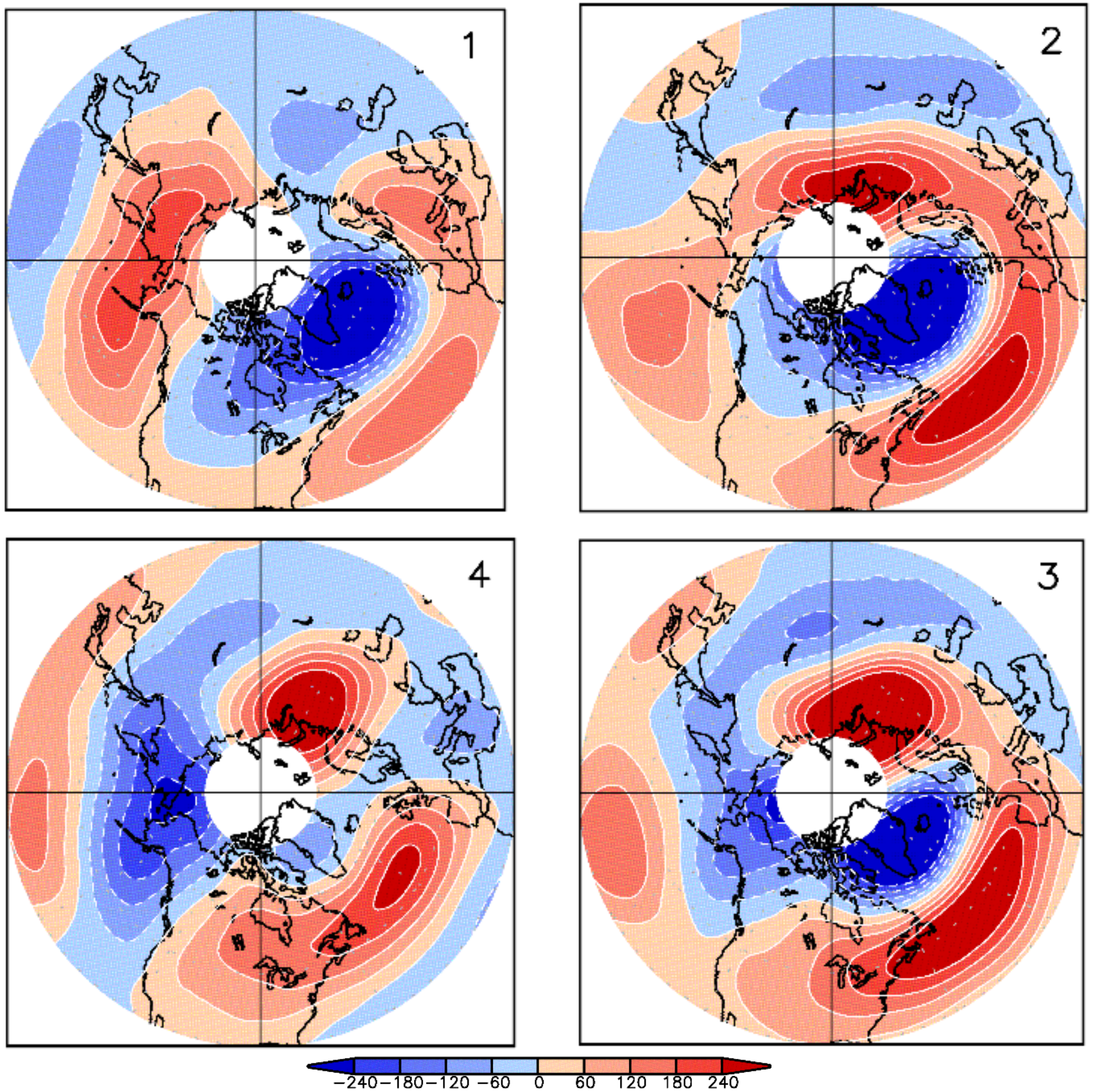
North Atlantic Oscillation







NAO Life Cycle



P1: Below average 500-hPa heights over Iceland and above average heights over the western Atlantic

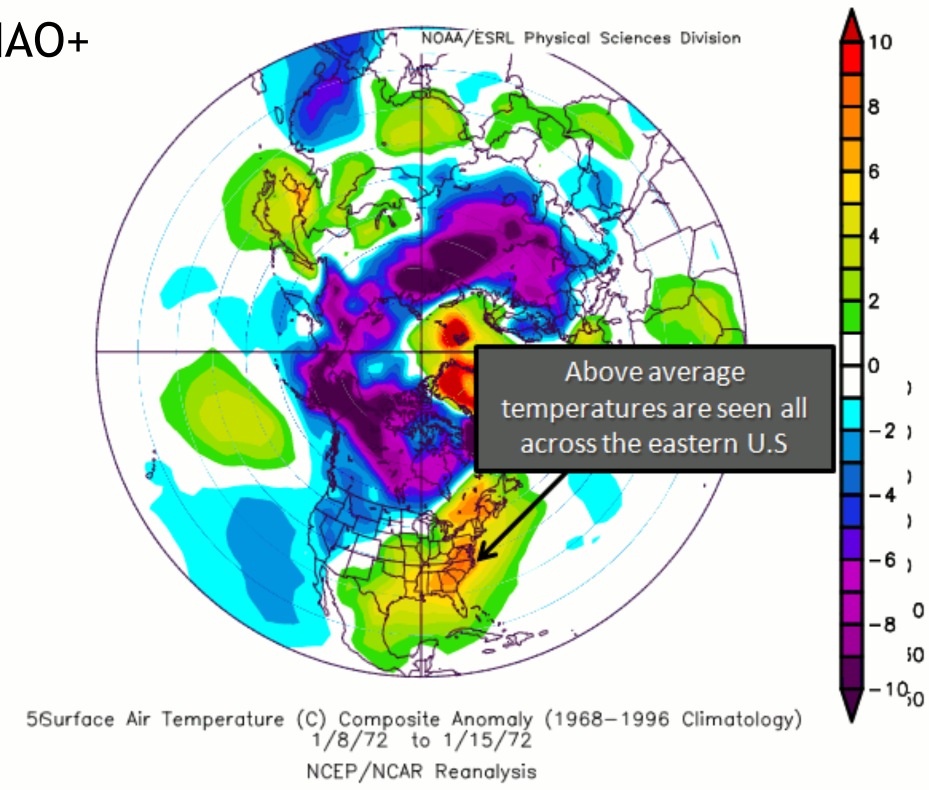
P2: Negative height anomaly retreats poleward and positive height anomaly expands westward over the eastern U.S.

P3: Negative height anomaly splits into two centers and the above normal height anomalies reach the west coast of the U.S.

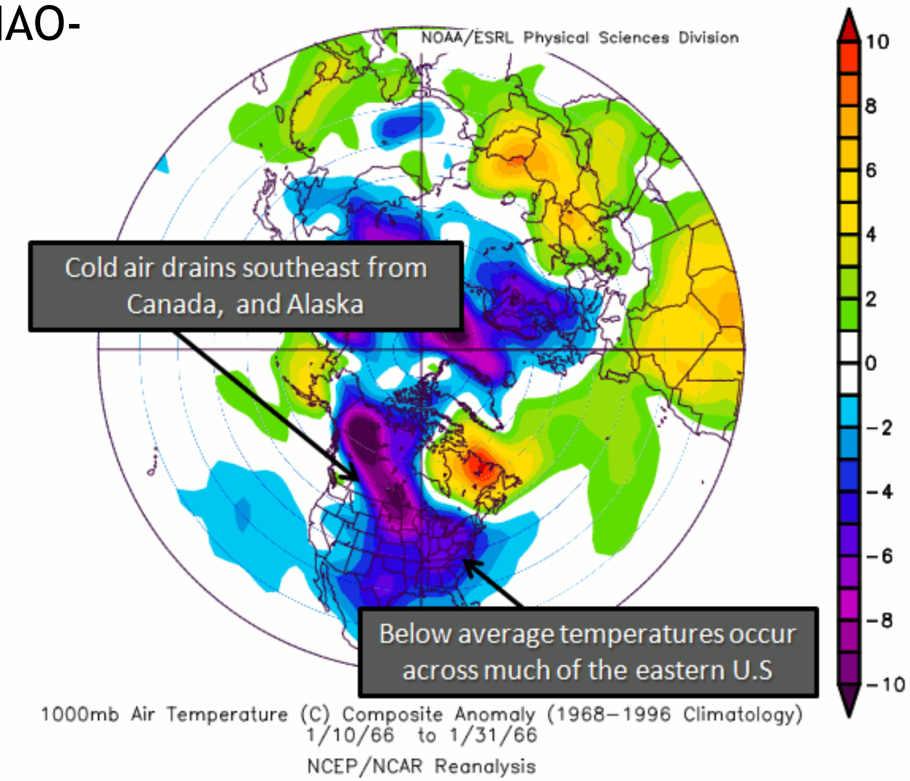
P4: Below average 500-hPa heights near Iceland are becoming replaced by positive anomalies and the above average heights over the North America become replaced by negative height anomalies propagating eastward from the North Pacific

NAO relationship to Surface Temperature

NAO+

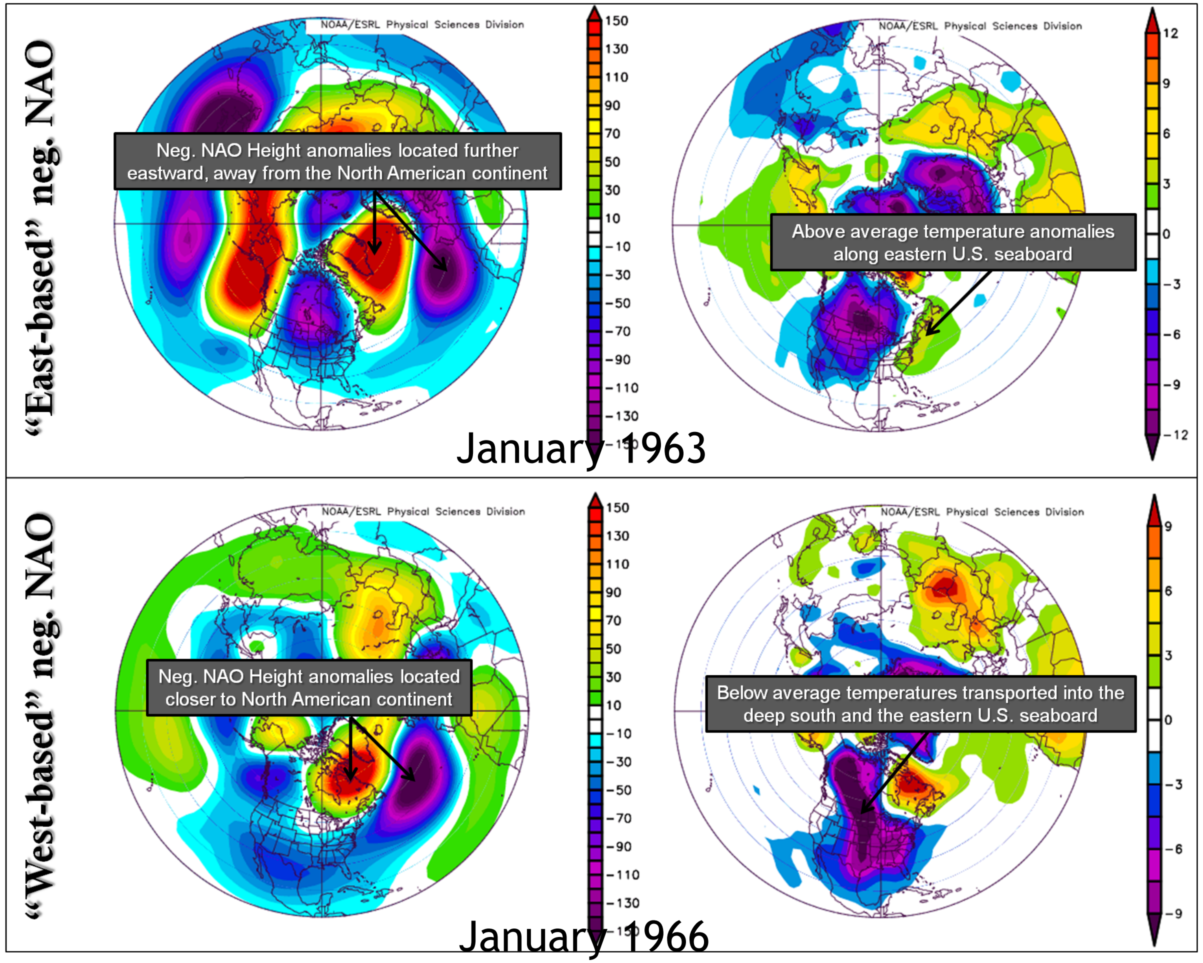


NAO-



State Climate Office of North Carolina
http://climate.ncsu.edu/climate/patterns/NAO.html

NAO relationship to Surface Temperature



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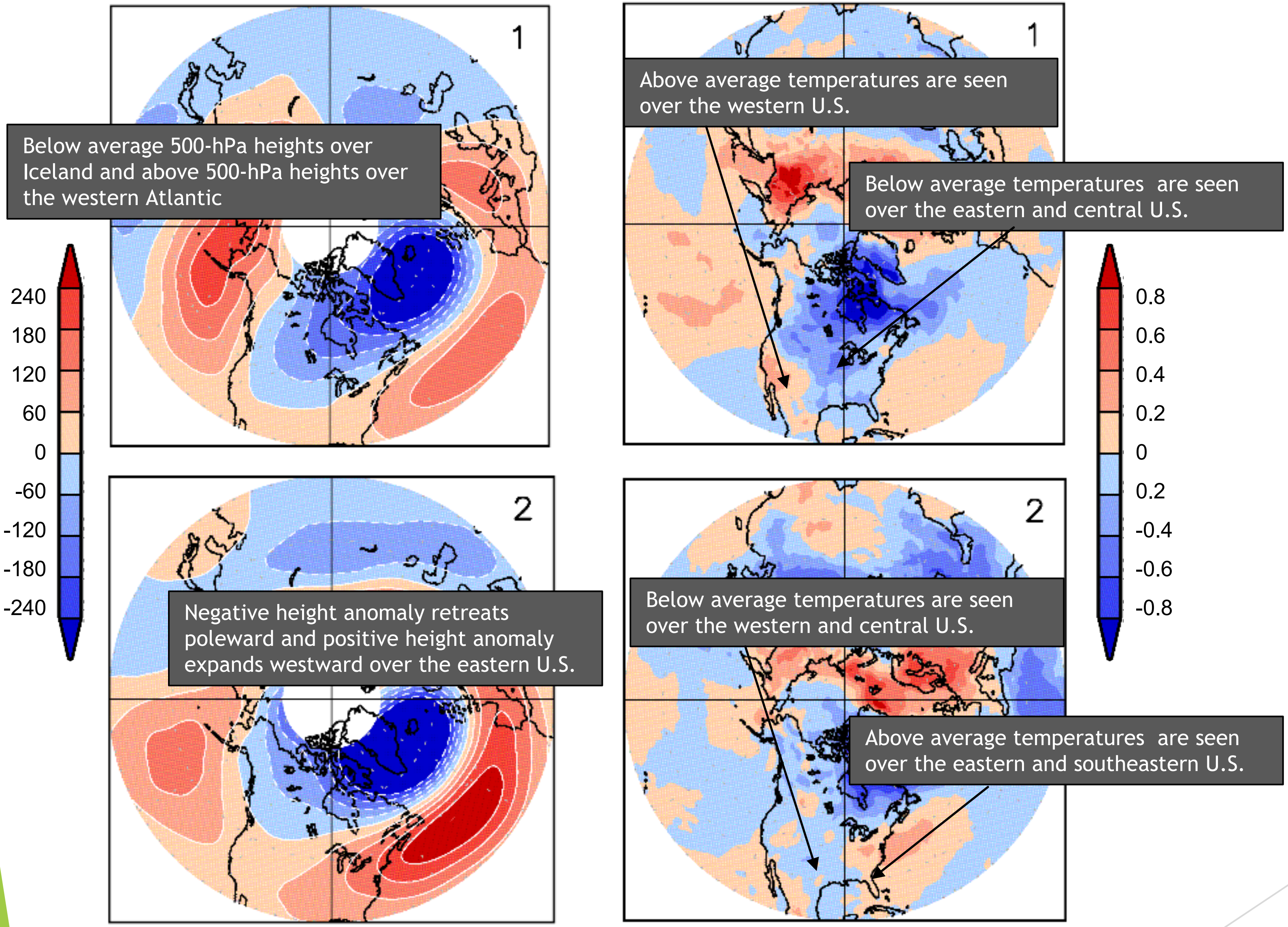
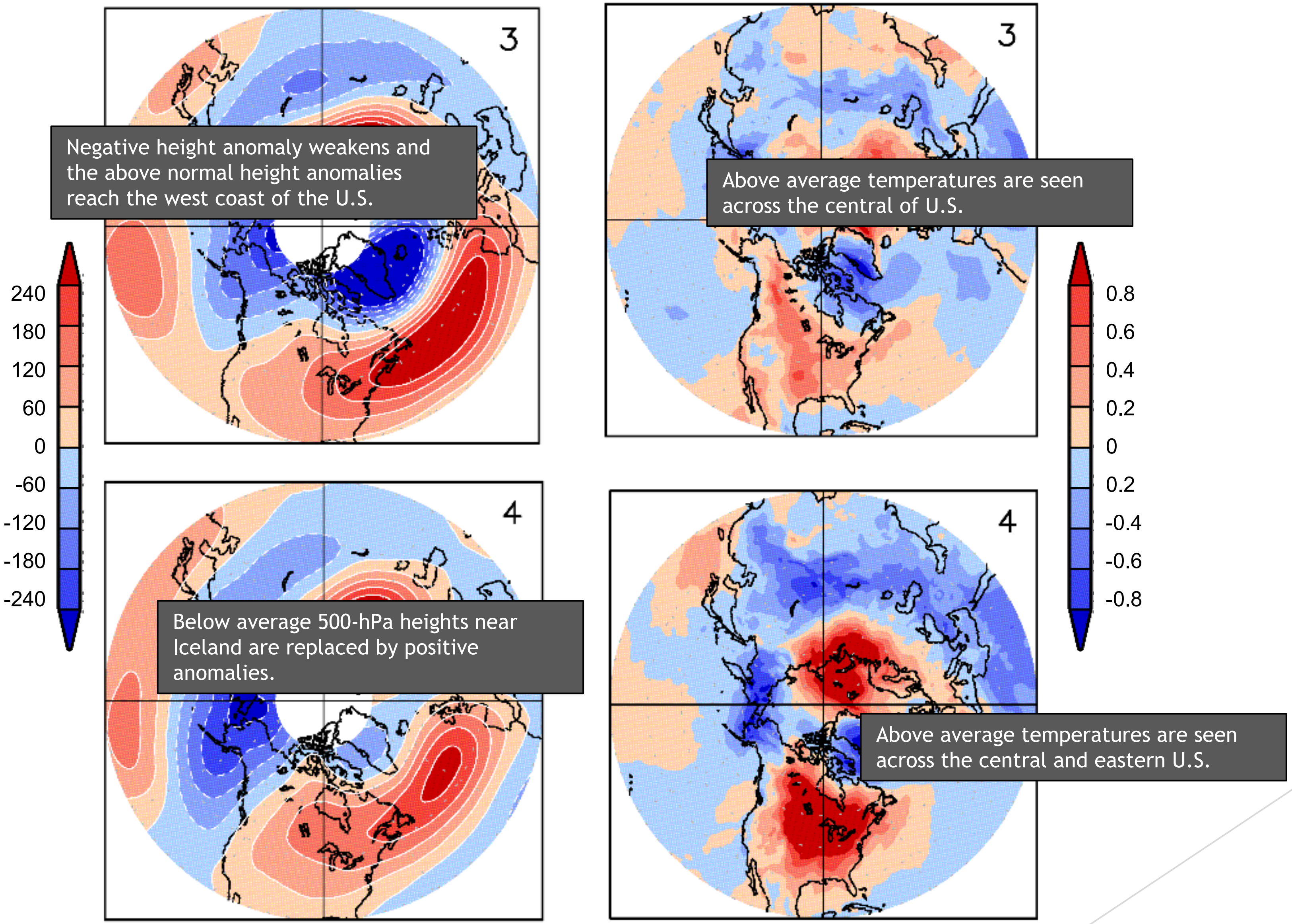
Surface Temperature Phase Composites



Surface Temperature Phase Composites



Negative height anomaly weakens and the above normal height anomalies reach the west coast of the U.S.

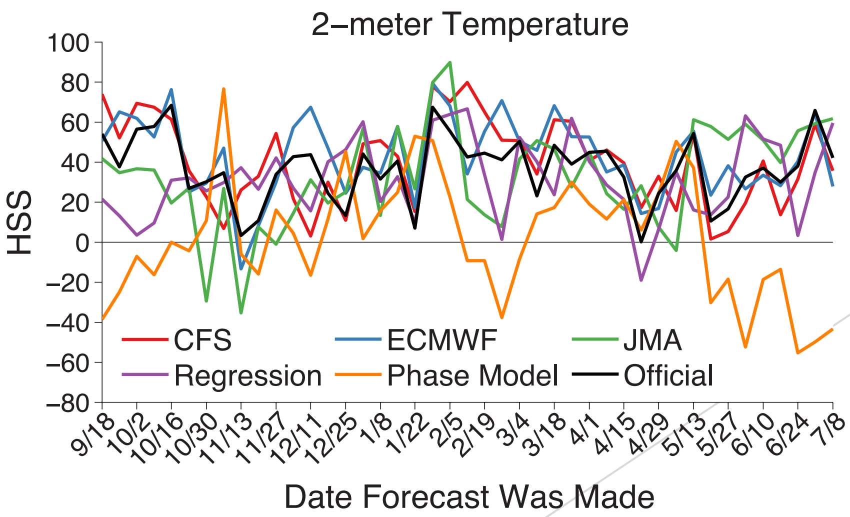
Above average temperatures are seen across the central of U.S.

Below average 500-hPa heights near Iceland are replaced by positive anomalies.

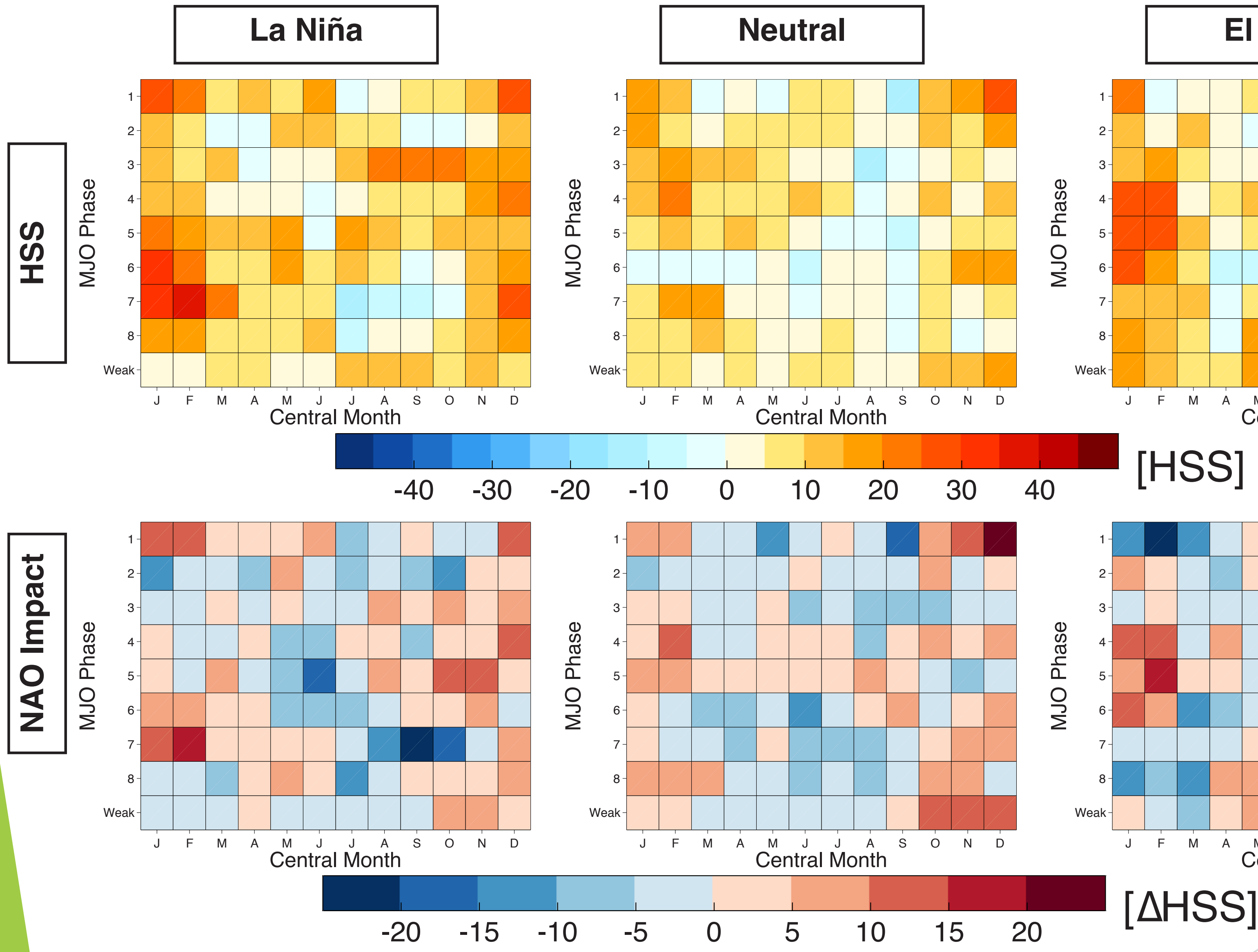
Above average temperatures are seen across the central and eastern U.S.

The Impact of NAO variability on Temperature Forecast Skill

- Statistical model using a multiple linear regression model (Harnos et al, 2016):
  - *Predictors:*
    - RMM1 and RMM2 for MJO
    - 2-week mean Nino 3.4 anomaly for ENSO
    - Daily NAO index from the MSSA analysis
    - Daily index for linear long-term trend
  - *Predictants:*
    - 2-meter Temperature
    - Precipitation



NAO Impacts on Week 3-4 U.S. Temperature Forecast



Improvements:

- Boreal Winter
- MJO over the Maritime Continent or Western Pacific
- Neutral ENSO years

Skill degradation:

- Boreal Summer
- MJO over the Indian Ocean

Conclusions

- The mid-latitude variability is characterized by propagating oscillations with periods of 120, 45, and 25 days
- The 120-day oscillation resembles the canonical NAO pattern
- The life cycle of the 120-day oscillation has an impact on the surface air temperature over the U.S.
- The daily variability of NAO can enhance the week 3-4 forecast skill of 2-m temperature over the U.S.